A Research plan on

"Smart Meter Network"

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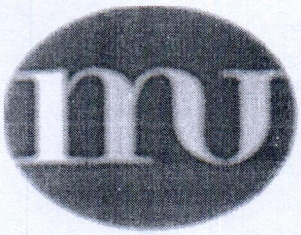

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Abstract: In the system and networks, abnormal behavior is detected by Anomaly-Based IDS (Intrusion Detection System). If the working of a computer system is different from normal working then it is considered as an attack. Malicious traffic or data on a system is detected by intrusion detection process. To detect illegal, suspicious and malicious information and data, IDS can be a part of the software or a device. IDS include different methods of detection and prevention of an attack. Intrusion detection is the user's highest priority. Anomaly-based IDS satisfy their requirement and demand.

In present scenario electricity theft is a major hurdle for government. This problem affects Indian economy. For example if there is a building of 20 houses and if somebody steals energy using some method then this affect all 20 house members. Hence power consumption of building increases than actual supply. Every house owner has to pay extra money for that. This is a big problem across India. The target of this proposal is to implement a wireless system to avoid the problems related to users for pay thieving bill. People are affording more charges because intruders steal electricity by many ways. Intruder saves his money but this creates a big loss to nation.

Motivation: Using different techniques of detection researchers are not guaranteed about sure levels of security and can't decide that received information is actual and precise. For security, researcher tends to use ADS (Anomaly Based System) algorithms. ADS algorithms use the system data and knowledge received to make a decision whether the working of the system is reliable or not. So researcher use different ADS algorithms with knowledge to accomplish objective and check discovery ability. Availability of data ensure guarantee of reliable access to the information by authorized people. Verification and privacy issue are solved with cryptographic algorithms and these avoid integrity attacks. Intrusion detection methods are used where the traditional or normal behavior differ. When researcher sees towards the power distribution sector of any country then researcher will get to know that, a major part of power is theft in many manners. At present we could not do much to stop with the old system. At present we are very much advanced in technology so we can use wireless technology for electricity distribution. If we implement the wireless technology in this field then we can get amazing returns and results. This is a major motivation behind this idea. The Researcher chooses the idea, if somebody steals electricity in a building then every owner that lives in that building have to

pay extra money by doing comparative study of different ideas of different authors[2][3][6][11]. In this research researcher present a comprehensive view of smart electricity meters and their utilization to remove intruders attack. Researcher explains brief idea of wireless communication and what technologies and software are used for increasing security and prevention of theft. Present scenario is that all countries are using smart meters to save energy and cost from intruders attack. It include easy billing , processing automatic reading, detection of energy losses and early warning of intrusion and fast detection of disturbances in energy supply. At present there are several energy stealing tricks about electric energy meter that affect totai consumption every month and in every year and due to some thieves, honest people have to pay.

Literature review: Idea of Smart meters was presented in early 2000s. It develops economic, social and environmental benefit. In this project researcher present a comprehensive view of wireless smart electricity meters and their utilization to remove intruders attack.

D. Alahakoon and Xinghuo Yu [1] in 2016 presented a comprehensive study of smart meter using AMI(Advanced Metering Infrastructure), LAN(Local Area Network) and WAN(Wide Area Network). How we can make energy use more efficient and effective. How energy is critical for future social and economic developments and proposed a framework for smart meter privacy.

Qie Sun, H. Li and Z. Ma [2] in 2016 added some more instructions in smart meter. They developed advanced meter to monitor and control house appliances and designed some devices according to need of consumers. They developed smart heat and gas meter with smart electricity meters.

W. Aslam and M. Soban [3] in 2015 proposed smart meter for measuring electrical parameters, periodic data recording and communication of data. They worked on this idea to make meter smarter as compared to others. They presented this idea of smart meter in 2015 including data gathering device and communication system used for data flow and at later stages developed a centralized management and control system.

› Jokar, N Arianpoo [4] 2015 presented idea to bring reliability, efficiency, flexibility, esilience, robustness, and consumer participation to the electricity system by adding a cyber ecurity. They used Cryptography solutions and key method challenges.

3. McLaughlin, D. Podkuiko and P. McDaniel[5] 2010 presented the design of advanced metering nfrastructure for efficient and low cost energy management system. It is based on sensor system o manage the power utilities. To decrease the fear of energy theft author created attack tree. Author collected data into different classes of attack and found the root cause of theft.

R. Berthier, William H. [6] 2010 explored the practical ways for monitoring intrusion detection by using AMI's different analysis ways. Author took the idea of three different classes to build secure architecture- prevention, detection and mitigation. They detects the problem in monitoring different communication networks using different intrusion detection techniques.

P. Parikh, , M. G. Kanabar and T.S. Sidhu [6] in 2010 propose low cost nature of wireless system in electric power system. The wired monitoring systems require expensive communication cables to be installed and regularly maintained so wireless communication is important in power system to maintain cost .

Victor C. M. Leung [7] in 2015 present consumption pattern based energy theft detector that predict the customer's malicious consumption pattern. By using these consumption patterns malicious customers can be identified. For this transformer meters and anomaly detectors are used.

S. S. Sreenad R.Depuru, Wang and V. devabhaktuni [8] in 2011 discussed factors which influences the consumers electricity. To detect and estimate the theft author proposes design of smart meter, external control station and filter circuit. So detection of illegal consumer and utilization of energy become easy and effective.

N. Mohammad, A. Barua [9] in 2013 proposes a prepaid energy meter to reduce electricity theft. The system was installed at every consumer site and there was a server at service provider side.

GSM module is used to equip both units which provide bidirectional communication. So consumer can recharge their meter by sending message to service provider.

C. Efthymiou and G. Kalogridis [10] described a method for sending electrical meter data by a smart meter every few seconds. This type of data is required to monitor electricity distribution network. This method is also required for other purposes such as billing, account management or marketing research.

N. Gupta and D. shukla [11] in 2016 proposed embedded technology for automated energy meter reading for removing electrical theft. This technology updated meter reading on timely basis which means on regular interval basis and sends bill to customer on monthly basis. It introduces the concept of prepaid and postpaid recharge of meter. For getting this service customer have to send message to service provider. People who are unaware of accessing internet for prepaid and postpaid recharge of meter scan also use the concept of automated meter reading.

In this research researcher will use smart meters on lighting pole, wireless transmitter and receiver module for wireless communication, programmable logic controller and one server system to know about energy losses or energy stealing at any point and at any time.

Smart meters are used or installed in homes and in other region of world. USA and Europe are using smart meters. Australia and Canada are also using this. Almost all countries like Eastern Europe America, North Africa, South Africa and Asia are using smart meters. Use of smart meters has increased more in year 2018 than previous years. Now if we talk about present scenario all countries are using smart meters to save energy and cost from intruders attack. It include easier billing , processing automatic reading, detection of energy losses and early warning of intrusion and fast detection of disturbances in energy supply. The researcher uses different idea of research on intrusion detection in energy by using smart meters, wireless transmitter and receiver module, profibus cable, PLC (Programmable logical Control) and SCADA (Supervisory Control and Data Acquisition) to take exact readings on every second and give information about consumption of energy on daily, weekly, monthly and yearly basis. We can find out energy stealing point atthe same time when intruder is stealing energy so that action

can be taken according to type of intrusion as early as possible. Hence chances of theft decease. It creates easy billing, reduces man power cost and provides safe and secure system.

Research Gaps:

- In the existing system (GSM based meters) if the mobile network is not available (due to natural disaster or some other natural calamities) then the data from the meters, cannot be fetched.

If the network of mobile provider is overloaded then it will affect the meter networks and data cannot be fetched.

- In the existing system if request to meter for sending meter data is placed, the meter sends the data in the form of data packets, it does not have live streaming provision.
- In existing meters electricity could be stolen bypassing the meters and physical damage to the meter terminals is possible. In the existing meters we cannot track the faulty meters in real time [3] .
- At present lineman manually record the total consumption of electricity and prepare bills. If any intruder damage the meter and cuts the communication cable then we are not able to recognize it easily. Intruders attacks on data confidentiality, integrity and availability [4].
- In existing system we cannot detect any type of faults and attacks in real time, when intruder is stealing electricity by some unauthorized method [12]. We detect problem in meters on the basis of average readings and consumers complain.

Objectives of research work

- To develop own **Wi-Fi** communication network with live streaming between PLC and smart meters.
- To develop a new smart meter system which is not dependent on mobile networks(GSM meters), SIM cards, data cards, data networks .
- To eliminate the traditional billing system this is inaccurate in terms of time consumption and manpower resource consumption.

- To design a new smart meter network system which will have high data communication speed then existing wired and wireless networks.

Research Plan: (Application oriented)

Description of Application:

Normally in all the houses we have electricity connection from EB (Electricity Board) and for all the connection we have one electricity meter outside the house to record the electricity consumption. Some of the people do the electricity theft by bypassing the meter or by doing unauthorized activity in the meter and nobody gets to know what happened to the meter. We have an application which can be implemented to minimize the same.

Proposed Algorithm:-

1. Install wireless transmitter and receiver module on lighting pole for wireless communication between EB office and meters.
2. Install one slave PLC on lighting pole which will communicate with smart meters.
3. Communicate slave PLC with wireless transmitter and receiver module which is at lighting pole. Download the program in slave PLC.
4. Install smart meters on lighting pole.
5. Connect input (current and voltage) to smart meter.
6. Install one more wireless transmitter and receiver module at EB office.
7. Install master PLC and computer system in working office of electricity board.
8. Communicate wireless transmitter and receiver module with master PLC through Ethernet cable, which is at EB office.
9. Install software (Simatic Manager and SCADA) in computer system.
10. Connect master PLC to system by Ethernet cable.
11. Communicate PLC and system (PLC to SCADA).
12. Assign ID to smart meters.
13. Communicate smart meters to slave PLC (installed at lighting pole) with profibus cable.
14. Now establish the communication between wireless transmitter receiver module to module (one is at EB office and another is at lighting pole).

15. After establish the module communication **we will establish the slave PLC to master PLC (EB office and lighting pole) wireless communication**.
16. Specify smart meters in PLC program and assign address to input.
17. Create point configuration in SCADA and assign address for each signal as specified in master PLC.
18. After that all information about nodes will display on screen (output).
19. If there is any hurdle in communication and I/O then check again step 3.

Phases that will be involved to carry out this proposed research work:

Phase-1

First researcher will install smart meters at lighting pole from there we are distributing the connections to each house and the connection will be through the smart meter. We will just give the input (voltage and current) to the smart meter. On basis of input it is having hundreds of parameters inbuilt to it, so it will calculate all components of power like KW (active power), KWh (power per hour), KVAR (reactive power), and KVA (apparent power) and send all these readings to slave PLC which is installed at lighting pole. For transfer of data it will use profibus cable communication.. To each smart meter researcher assign a ID no. all the smart meters are installed at lighting pole inside one common box and from there individual cable will directly go to each customer through smart meter.

Phase -2

After installation of smart meters, we will set up one slave PLC on the same lighting pole, that PLC is connected with all smart meters. And will establish the communication with all smart meters.

Phase -3

After installation of slave PLC we will install wireless transmitter and receiver modules on the same box where the slave PLC is installed. After installation we will establish a connection between wireless module and PLC. And power up the system. After that we need to download the program in slave PLC. It will communicate with all the smart meters and can send and receive data to smart meters.

Phase -4

Now we will install one master wireless transmitter and receiver module at electricity board office. Also we will install one master PLC at same office.

Phase -5

Establish a communication between master PLC and master wireless transmitter and receiver module.

Phase -6

Researcher installs one server and one operating system both will be loaded with PLC software programming and SCADA (HMI (Human Machine Interface) Software) and both are connected with PLC. All the program and changes in the program can be made through these operating stations.

Phase -7

Now the important part is to communicate master PLC to slave PLC through wireless communication, since slave PLC is already communicated with smart meters and wireless module and master PLC also communicated with wireless module. Now slave PLC will send the smart meter data to master PLC through wireless communication so for that we need to do signal address mapping, in that we specify in master PLC that the data address of slave PLC. Suppose slave PLC is sending voltage signal and suppose its address is I28.1(input 28.1) in slave PLC so the same address will be specified in to master PLC with description of voltage signal. So if master PLC receive this input at its address it will display the same on SCADA screen. This is what we have to do for all signals.

Phase -8

If anybody is doing something with meter on the poles, all the readings will became zero on system. The person who is monitoring all the nodes will get message that something wrong with that particular node. So he will tell lineman to check the node but if anybody does with communication line then in that case that particular node will blink as bus fault. It means there is a communication failure with that particular node. So the person who is monitoring the system will ask to check that particular meter.

Phase -9

There is a big advantage of this system

1. First it is wireless communication
2. There is no need to reach each and every house to take reading for billing. The PLC and SCADA will automatically generate the monthly consumption report for each node (meter) and we will also have option to generate daily, weekly, monthly and yearly report for each node. We

can continuously monitor the consumption of each customer and directly we can generate the bills. So we can replace manual reading taking procedure and can save manpower cost.

By using this idea we use and learn some programming and software to decrease energy stealing and reduce theft. This idea is used to save losses. The electric energy meter mainly works according to the relationship with voltage, electric current and power factor angle. The behavior of electricity stealing not only makes the power industry suffering from huge financial losses but also affect the main power supply security.

At present there are several energy stealing trick about electric energy meter that affect total consumption every month and year so for only some thieves, every honest people are to pay. So researcher can save money of customer and government. The researcher can calculate total power consumption of particular house and a town monthly.

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